SRSFC Project 2019 R-15 Research Proposal Report

Title: Efficacy studies of major fungicides for management of downy and powdery mildews of grape

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Objective:

Determine the relative efficacy of all major fungicides utilized for control of downy and powdery mildew of grape

Justification and Description:

The southeastern wine grape industry is still relatively young and fragile. Economical losses from downy (*Plasmopara viticola*) and powdery (*Erysiphe necator*) mildews are significant and threaten to reduce productivity on a yearly basis. Indeed, losses have been significant enough that no wine is produced in some locations in most years. Though downy mildew is an important disease for grape growers worldwide, the southeastern environment is perfect for disease development. *P. viticola* infects and reproduces on berries, pedicels, and the undersides of grape leaves (Fig. 1), reducing photosynthesis and rendering the fruit unusable. In severe cases, leaf drop will decrease the vine's overwintering potential as a result of winter injury/kill. Downy mildew thrives on *V. vinifera*, hybrids and even some natives, which account for most of the cultivars grown in the Southeast. Powdery mildew is particularly aggressive as a pathogen of *V. vinifera* grapes, but it can attack some hybrids as well. Damage to berries can result in additional rot development and poor wine quality; leaf damage can also result in reduced photosynthesis and premature defoliation when disease is severe (Fig. 2).

To minimize downy and powdery mildew losses, grape growers spray fungicides throughout the season and even after harvest (to protect leaves and reduce overwintering inoculum). As a result, growers may employ thirteen to seventeen fungicide sprays in a growing year. Growers need a clear understanding of the rankings of fungicides utilized for both of these diseases. Though numerous efficacy trials are conducted on a yearly basis, rarely are all major fungicides compared head to head for efficacy and phytotoxicity. Such studies are necessary if growers are to best utilize these materials in their spray programs. The following studies were conducted in order to give southeastern growers the best information relative efficacy of current fungicides for management of these two challenging diseases.

Figure 1. Downy mildew sporulation on berries (top) underside of leaves (bottom left) and subsequent defoliation (bottom right).

Figure 2. Powdery mildew of grape on fruit and leaves.

Materials and Methods for Downy and Powdery Mildew Field Trials:

Efficacy of eleven grapevine downy mildew (DM) and eleven powdery mildew (PM) fungicides were tested on a block of 'Merlot' and 'Chardonnay' vines, respectively, located at the University of Georgia Research and Education Center in Blairsville, GA. All treatments were applied with a CO2 sprayer until runoff. Rates were calculated to correspond with a 50 gal per acre spray volume. Treatment dates were 23 May (prebloom), 11 Jun (bloom), 25 Jun (first cover), 9 Jul (bunch closure), and 23 Jul (second cover). Downy mildew treatments were as follows: 1) an untreated control [no material applied], 2) Abound, 3) Tanos, 4) Pristine, 5) Prophyt, 6) Forum, 7) Captan, 8) Phiticide, 9) Prophyt + Captan, 10) Ranman, 11) Prophyt + Ranman, and 12) Revus. Powdery mildew treatments were as follows: 1) an untreated control [no material applied], 2) Stylet Oil, 3) Inspire Super, 4) Abound, 5) Microthiol Disperss, 6) Rally 40WSP, 7) Pristine, 8) Torino, 9) Aprovia, 10) Luna Experience, 11) Vivando, and 12) Quintec. The experiments were designed as randomized complete blocks with six replications for each treatment with each plot consisting of a single vine. Cultural practices mimicked commercial production, and any additional pest management products were applied with an airblast sprayer at a rate of 50 gal per acre. After disease onset, DM and PM incidence (number of infected leaves out of 25 per plot) and DM and PM severity (percentage of leaf area affected for 25 leaves per plot) were taken after completion of the fifth spray. For PM, disease incidence (percentage of infected clusters) and severity (average percent cluster covered with mildew) data was also taken for five clusters per plot. Fruit was rated for PM coverage on 7/11/2019 and 7/26/2019 using the Powdery Mildew Assessment Tool by the Adelaide Research and Innovation Pty Ltd. On 8/6/2019 and 8/13/2019, 25 leaves were taken from each vine and assessed for incidence and severity of powdery mildew. Downy mildew incidence and severity data were collected for leaves on 20 Aug (~ 1 month after the last fungicide application).

Results and Discussion:

Efficacy of eleven different fungicides treatments were tested for downy mildew control, and fungicides separated into two main categories: good to high efficacy and no efficacy (QoI fungicides) – essentially the same as an untreated control (Figs. 3-4). This trial clearly documented field resistance of downy mildew to the QoI fungicides and confirmed the total lack of activity by these fungicides in the presence of resistant populations. In the powdery mildew trial, fungicides separated into four efficacy categories: high, good, poor and no efficacy (QoI and DMI fungicides) – again essentially the same as an untreated control (Figs. 5-8). This trial clearly documented field resistance of powdery mildew to the QoI fungicides and confirmed the lack of activity by these fungicides; in addition, this trial provided the first report of DMI resistance in grape powdery mildew in Georgia, as observed with the Rally treatment.

Among the downy mildew fungicides, the CAA (e.g. Revus), phosphonates (e.g. Prophyt), and others provided sufficient efficacy. Likewise, several fungicidal classes were active against powdery mildew. It will be critical to maintain the SDHI (e.g. boscalid found in Pristine), but rotation with other classes should help to deter or prevent resistance development in the remaining fungicides. Sulfur (e.g. Microthiol disperse) continues to provide good to excellent efficacy against powdery mildew, and resistance is not an issue with this class; greater incorporation of sulfur, when possible, should be considered as a critical part of a resistance management program for powdery mildew of grape.

Impact:
As a result of vineyard surveys and field trials conducted in 2019, we now know that resistance of downy and powdery mildew, devastating diseases of grapes in Georgia, to the quinone outside inhibitor (QoI) fungicides is widespread in the northern vineyards, and these fungicides no longer control downy or powdery mildew in many locations. In addition, we realize that the DMI fungicides (e.g. Rally) are also developing resistance in powdery mildew populations. Rotation among all active chemical classes will require producers to purchase multiple chemicals that will be utilized only once per season, but alternation of chemical classes is critical to maintaining these fungicides for years to come. In addition, sulfur will need to be utilized more effectively in the future, and additional studies will be conducted to develop the best-management programs for powdery mildew management going forward. We have already essentially lost the QoIs, and we may be losing the DMIs. We simply can't afford to lose more fungicide classes if we are to manage these aggressive diseases in the future. Producers are now receiving the critical information they need to prevent them from wasting money on fungicides that no longer have activity, while also providing better disease control and better grape production for higher wine quality.

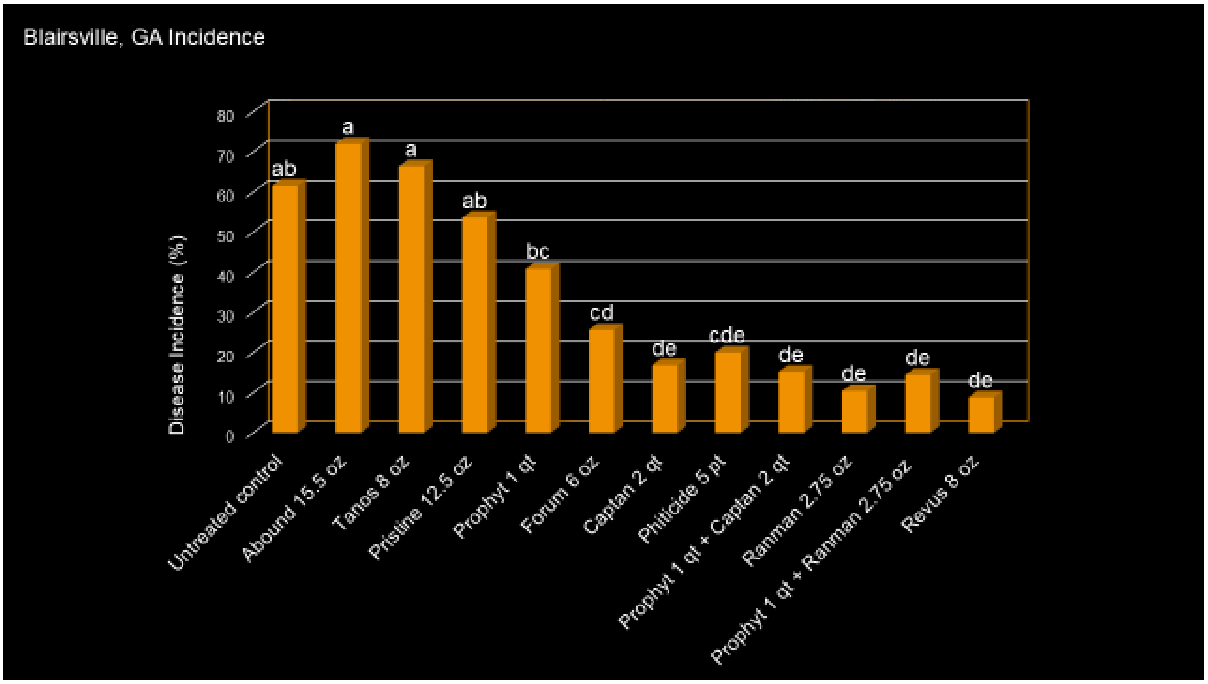

Figure 3. Downy mildew disease incidence (% infected leaves) following treatment with multiple fungicides. Abound, Tanos, and Pristine contain strobilurin fungicides, and resistance has been confirmed for downy mildew isolates at this field site.

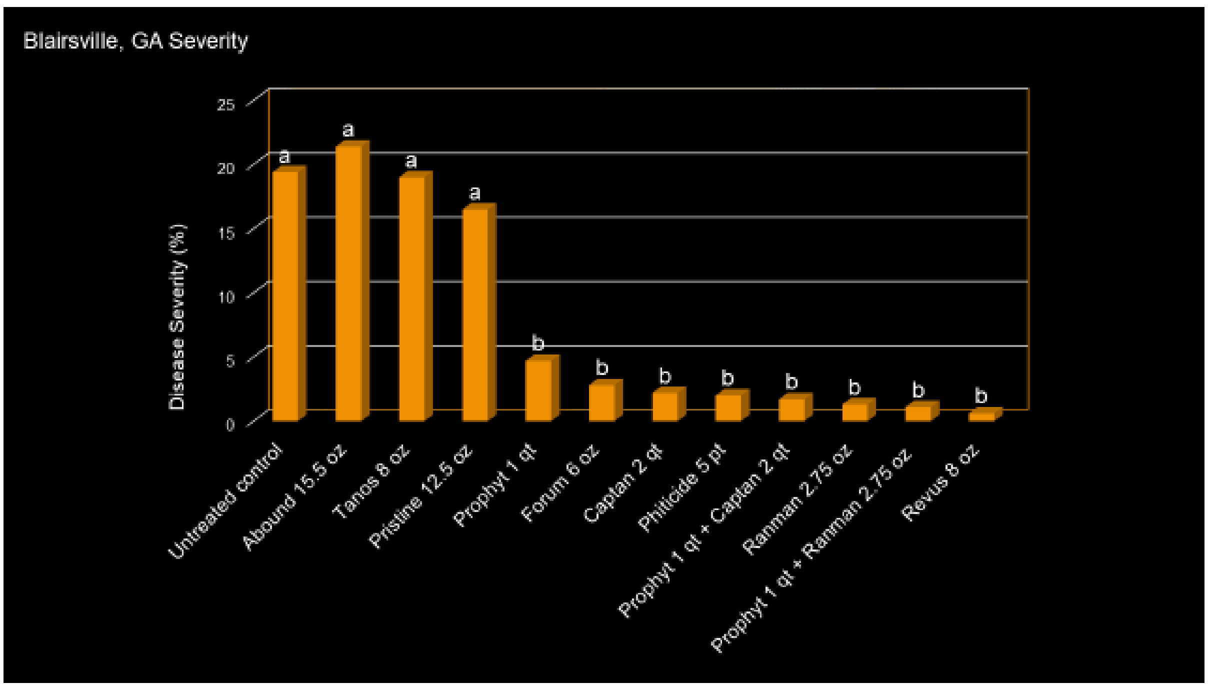

Figure 4. Downy mildew disease severity (% of leaf surface covered by downy mildew) following treatment with multiple fungicides. Abound, Tanos, and Pristine contain strobilurin fungicides, and resistance has been confirmed for downy mildew isolates at this field site. This data clearly shows the failure of the strobilurins for management of downy mildew. Other fungicide classes generally provide good to excellent control of downy mildew. Rotation with as many fungicide classes as possible will be needed in order maintain these fungicides for future use.

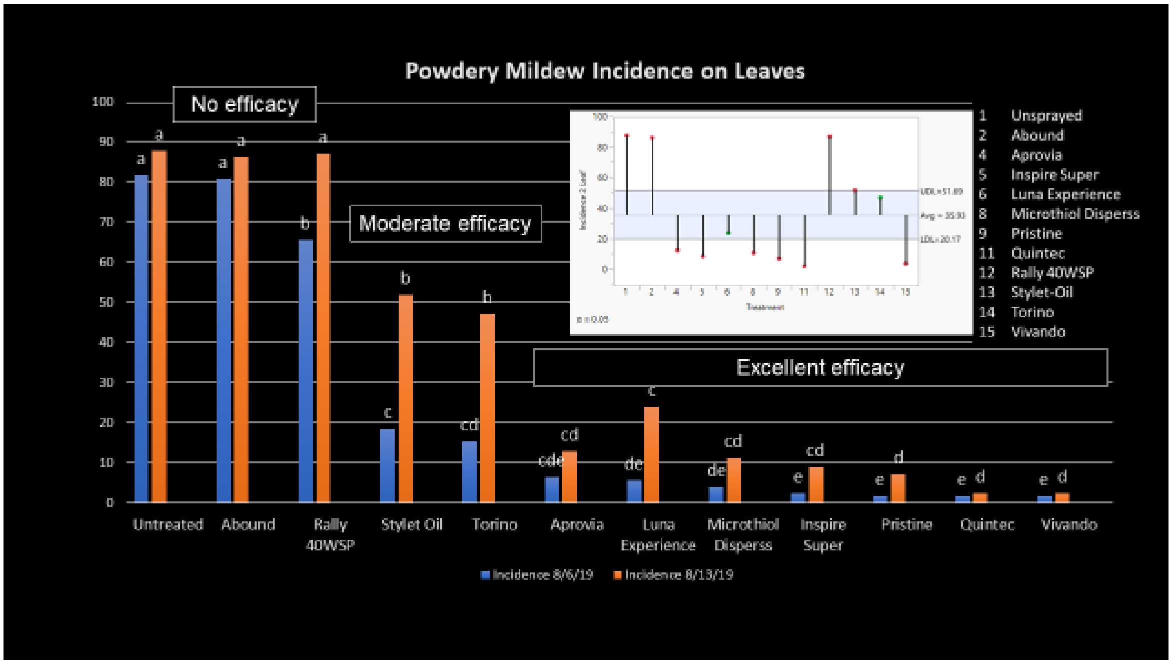

Figure 5. Powdery mildew disease incidence (% of leaves with powdery mildew) following treatment with multiple fungicides. Abound contains a strobilurin fungicide only, and resistance of the powdery mildew fungus to the strobilurins has been confirmed at this field site. Pristine also contains a strobilurin, but the SDHI boscalid is still very active against powdery mildew. This data clearly shows the failure of the strobilurins for management of powdery mildew, but it also shows that the DMI fungicide Rally is failing to control the disease as well, also due to confirmed resistance development. An analysis of means (upper right graph) likewise shows the failure of Abound and Rally.

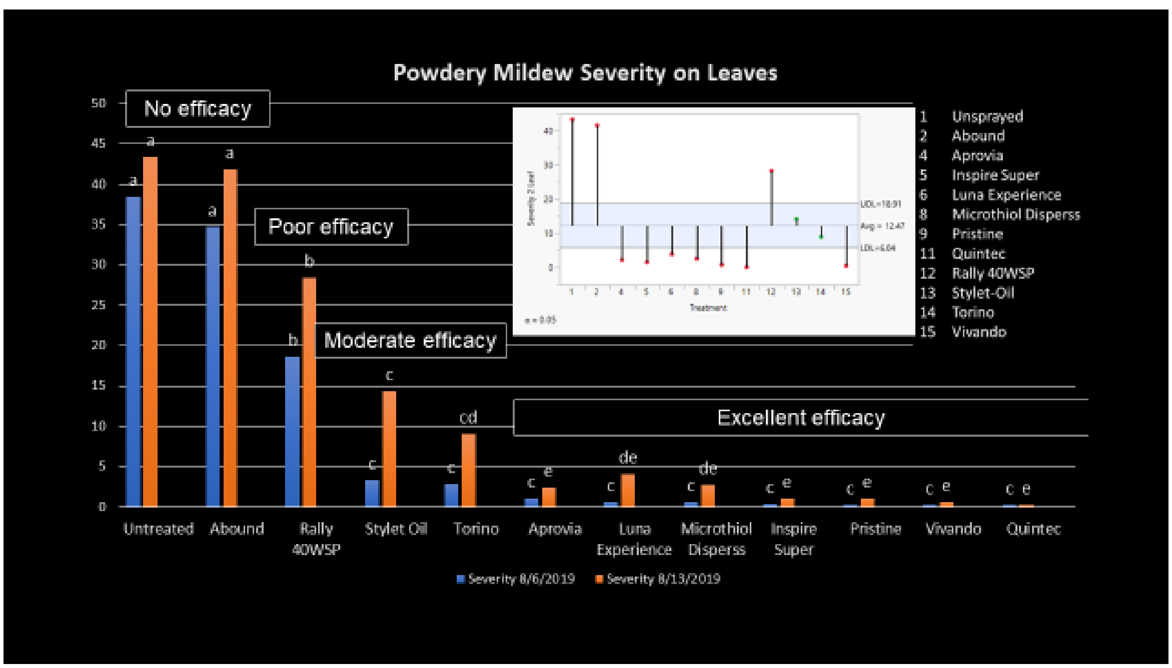

Figure 6. Powdery mildew disease severity (% of leaf coverage with powdery mildew) following treatment with multiple fungicides. Abound contains a strobilurin fungicide only, and resistance of the powdery mildew fungus to the strobilurins has been confirmed at this field site. Pristine also contains a strobilurin, but the SDHI boscalid is still very active against powdery mildew. This data clearly shows the failure of the strobilurins for management of powdery mildew, but it also shows that the DMI fungicide Rally is failing to control the disease as well, also due to confirmed resistance development. An analysis of means (upper right graph) likewise shows the failure of Abound and Rally. Note that the degree of the failure of Rally may not be as strong as that observed with Abound, which is expected with a DMI (quantitative resistance) versus a strobilurin (qualitative resistance).

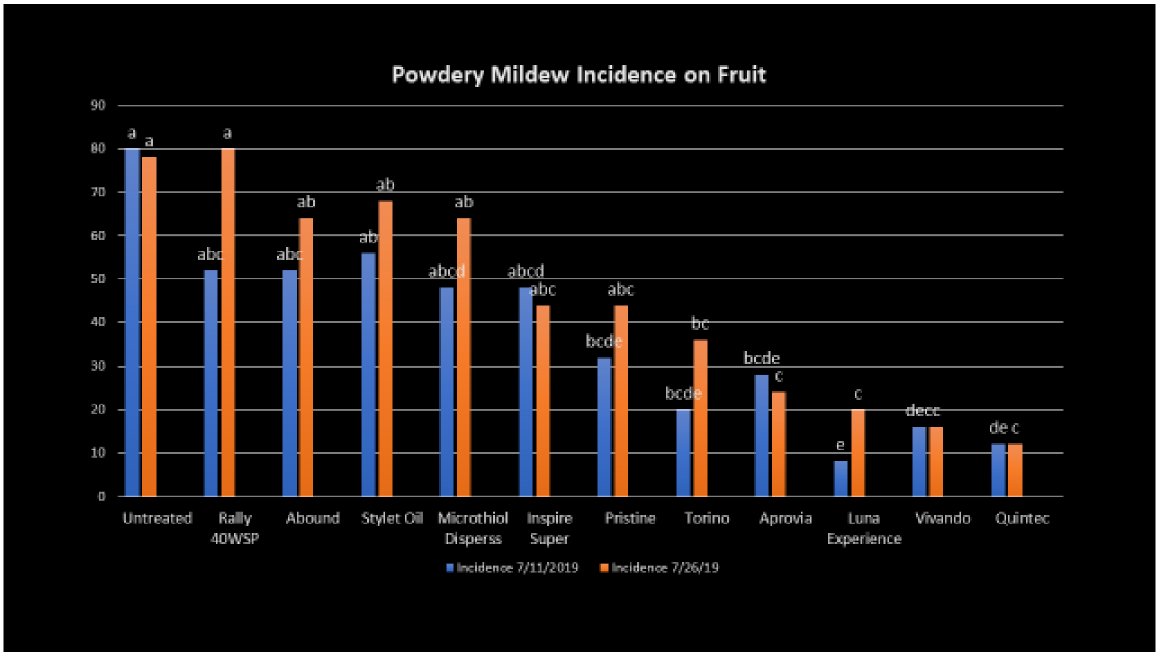

Figure 7. Powdery mildew disease incidence (% of fruit clusters with powdery mildew) following treatment with multiple fungicides. In general, a high percentage of clusters showed some powdery mildew. This was likely due to poor coverage, long intervals (2 weeks) between applications, and/or the fact that all plants were surrounded by untreated vines that were inundated with powdery mildew.

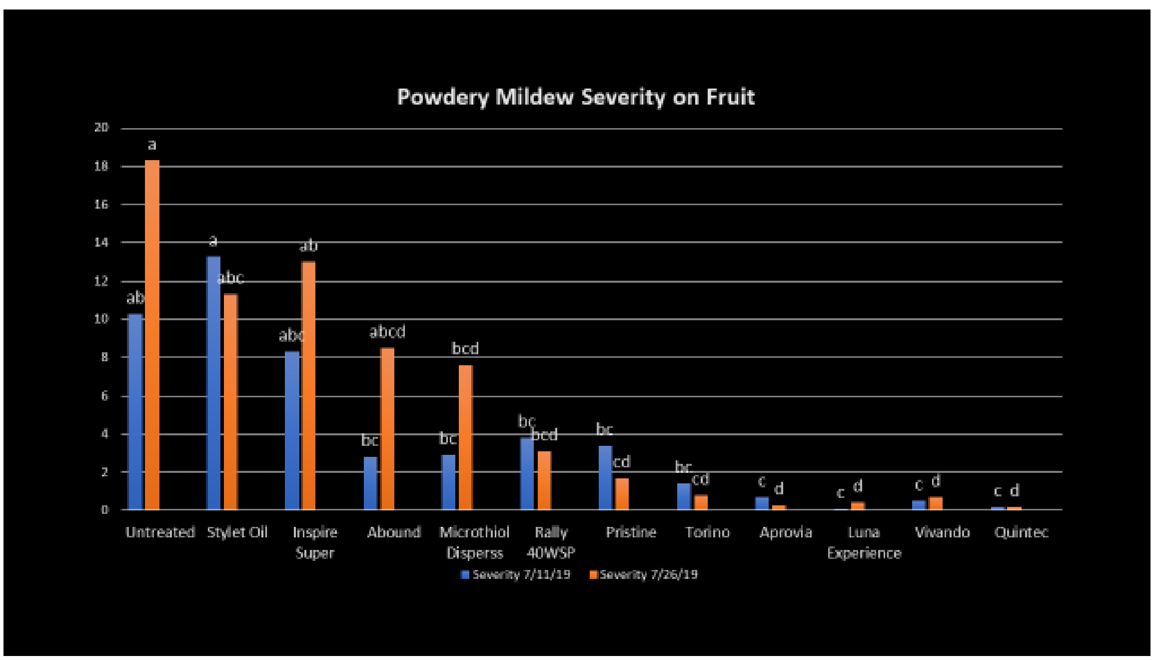

Figure 8. Powdery mildew disease severity (% of fruit cluster coverage with powdery mildew) following treatment with multiple fungicides. In general, a high percentage of clusters showed some powdery mildew. Several fungicides gave excellent control of mildew; among these were Pristine, Torino, Aprovia, Luna Experience, Vivando and Quintec.